# Kinematics, Forces, Work/Energy/Power:

S: scalar
V: vector

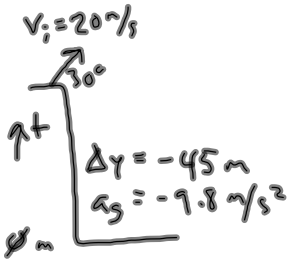
| | Variable: | Unit: |
|---|---|---|
| V | a → acceleration | $m/s^2$ |
| V | v → velocity | m/s |
| V | x → position | m |
| V | $\Delta x$ → displacement (change in position) | m |
| S | t → time | s |
| S | $\omega$ → angular frequency (SHM) / angular speed (circular motion) | rad/s |
| S | f → frequency | 1/s |
| S | T → period | s |
| S | W → work | J |
| S | P → Power | W |
| V | F → Force | N |
| S | m → mass | kg |
| S | E → Energy | J |
| V | $\tau$ → torque | J |
| V | p → momentum | kg·m/s |
| S | $\theta$ → theta | degrees |
| S | A → amplitude | m |
| S | $\mu$ → coefficient of friction | — |

| | Variable | Unit: |
|---|---|---|
| V | J → impulse | N·s |
| S | U → potential energy | J |
| S | K → kinetic energy | J |
| S | r → radius | m |
| V | α → angular acceleration | $rad/s^2$ |
| S | k → spring constant | N/m |

A stone is thrown from the top of a building upward at an angle of 30.0 degrees to the horizontal with an initial speed of 20.0 m/s. The height of the building is 45.0 m.

a) How long does it take the stone to reach the ground?

b) What is the speed of the stone just before it strikes the ground?




$v_{ix} = 17.2$ m/s

$v_{iy} = 10$ m/s

a) $\Delta y = v_{iy}t + \frac{1}{2}a_g t^2$

do not use

$t = -2.11$ s, 4.22 s

b) $v_f = ?$ $t = 4.22$ s $\Delta x = ?$

$v_{fx} = ?$ $a_x = 0$ m/s² $\Delta y = -45$ m

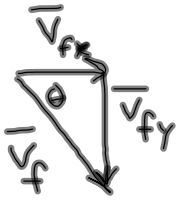
$v_{fy} = ?$ $a_g = -9.8$ m/s²

$v_{fx} = v_{ix} + a_x t$

$= v_{ix} = 17.2$ m/s

$v_{fy} = v_{iy} + a_g t$

$= -31.3$ m/s




$\vec{v}_f = 35.7$ m/s @ 61° S of E

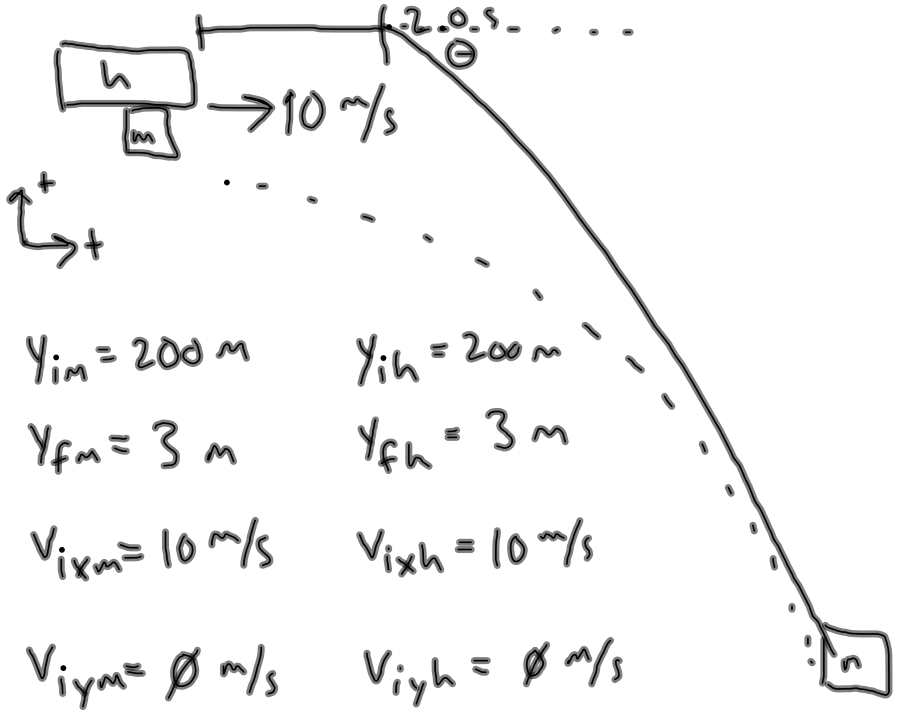
**Semester Exam Review AP Physics 1.3.12**

A hawk is flying horizontally at 10.0 m/s in a straight line, 200 m above the ground. A mouse it has been carrying struggles free from its talons. The hawk continues on its path at the same speed for 2.00 s before attempting to retrieve its prey. To accomplish the retrieval, it dives in a straight line at constant speed and recaptures the mouse 3.00 m above the ground.

a) Assuming no air resistance acts on the mouse, find the diving speed of the hawk.

b) What angle did the hawk make with the horizontal during its descent?

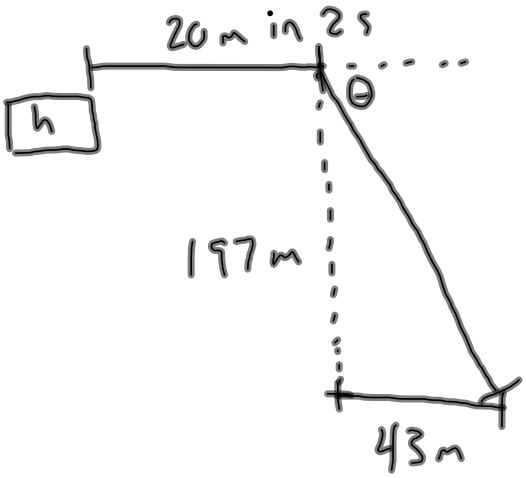
c) For how long did the mouse "enjoy" free fall?




mouse: $\Delta y = v_{iy}\cancel{t}^{0} + \frac{1}{2} a_g t^2$

$$t = \sqrt{\frac{2\Delta y}{a_g}} = 6.34\ s$$

hawk:




$$\theta = 77.6^\circ \text{ S of E}$$